The anisotropy of magnetic susceptibility in fine-grained, siliciclastic natural and experimental rocks – a critical assessment of its relationship to tectonic strain

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The anisotropy of magnetic susceptibility (AMS) is a commonly used petrofabric tool. One of the standard AMS graphs is the Jelinek graph, in which the shape parameter T ($-1 \leq T \leq 1$; -1 = prolate and 1 = oblate) is plotted against the corrected degree of anisotropy Pj (≥ 1). On such a graph, data sets of deformed sedimentary rocks often show a distinctive pattern of rather constant or slightly increasing Pj values for slightly prolate to slightly oblate ellipsoids, changing into rather constant to slightly increasing T values with increasing Pj for more oblate ellipsoids. Although often interpreted in terms of strain, this hockey-stick/boomerang shaped pattern is far from understood.

We examined these trends using fine-grained, very low-grade metamorphic, single-phase deformed, Palaeozoic siliciclastic samples of the Armorican Massif (France), diagenetic, regionally undeformed, Miocene siliciclastic samples of the Waitemata Basin (New Zealand) and samples of experimentally produced fine-grained turbidites. For the French samples AMS is controlled by paramagnetic carriers and for those from New Zealand by paramagnetic and ferromagnetic carriers. The experimental turbidites are composed of traces of multi-domain titanomagnetite in a diamagnetic matrix.

Our results show that these trends on the Jelinek graph do not necessarily reflect hard-rock strain. In the French samples, the variation in Pj and T reflects the quartz/white mica ratio. In the New Zealand samples, slumped sequences have a lower Pj and more prolate ellipsoids than undeformed layers. Finally, experimental turbidites have lower Pj and T in distal positions than in proximal positions.